New Vegetation Index Dataset Available to Monitor Global Change

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A consistent, two-decade or longer vegetation record is needed to detect trends in global land cover and climate change. With the longest record starting in 1981, vegetation data from the Advanced Very High Resolution Radiometer (AVHRR) has played a key role in detecting changes in vegetation caused by global temperature increases. NASA's Global Inventory Modeling and Mapping Studies (GIMMS) group has recently produced a new global vegetation dataset at 8km resolution from 1981 to 2004. Maximizing the length, stability and quality of the AVHRR dataset, the GIMMS Normalized Difference Vegetation Index (NDVI) data will enable new earth science conclusions and continuous monitoring of vegetation dynamics during the next decade.

Since the first demonstrations of the capability of the AVHRR to measure earth surface conditions (Tucker, 1985), there has been intense interest in using the continuous record to monitor earth surface conditions at a regional to global scale. Spectral vegetation indices are the most widely used of any of the products derived from the AVHRR instruments (Cracknell, 2001), a development not anticipated by the designers of the AVHRR instruments. Using AVHRR data, Myneni et al 1997 showed evidence of a lengthening of the growing season at northern latitudes (Myneni et al., 1997). Recently, Nemani et al. 2003 showed that changes in the climate caused a net primary production increase of 6% (3.4 petagrams of carbon over 18 years) (Nemani et al., 2003). However, these and other authors have had to resort to *ad hoc* corrections and to adopt various vicarious calibration strategies in order to use the data.

NDVI from the AVHRR record suffers from some significant limitations, including the use of outdated and inadequate calibration, partial atmospheric correction, and small signal to noise ratios (Tucker et al., 2005). AVHRR has significantly more problems in correcting for atmospheric effects than the newer sensors designed to measure vegetation dynamics due to wide spectral bands. The AVHRR sensor also has the additional problem of having data from seven different AVHRR instruments on six NOAA polar orbiting meteorological satellites that suffer from orbital drift (Cracknell, 1997; Kidwell, 1998; Kidwell, 2000). The GIMMS dataset removes the effects of these issues with a correction using Empirical Mode Decomposition (EMD) designed for non-parametric and non-stationary data (Pinzon et al., 2005). These corrections result in a stable time series appropriate for trend analysis (Figure 1).

The GIMMS dataset integrates the most recent AVHRR instruments (NOAA-16 and 17) into the historical continuum of AVHRR data. By intercalibrating these data with NDVI from SPOT Vegetation and the MODIS instrument on Terra, we have improved the usefulness of the long-time series record. Benefits of the intercalibration include using longer time series means to calculate anomalies, being able to use SPOT Vegetation and

MODIS Terra NDVI data quantitatively with respect to a 24-year NDVI record, and having multiple NDVI data sources in case one or more satellites or instruments fail. We have been able to process the AVHRR NDVI 1981 to 2004 historical record within the MODIS, SPOT VGT and SeaWIFS NDVI data dynamic range (Figure 2). This has been done without resorting to ad hoc, regression or statistical techniques that reduce the data's independence from other satellites. The new range enables the many advantages of MODIS data to be used while retaining historical information from areas of interest, albeit at a much reduced spatial resolution. The new dataset that differs from previous AVHRR datasets only in range and noise level, and should allow an easier transition for users of global coarse resolution NDVI data to the new generation of sensors. In addition, information from MODIS and other new sensors can be used to understand better the historical dynamics in AVHRR NDVI.

In November 2004, the GIMMS AVHRR NDVI dataset will be available at the University of Maryland's Global Land Cover Facility (http://glcf.umiacs.umd.edu) in the original bimonthly, continental, Albers Equal Area projection, binary files at 8km, and bimonthly in a global latitude/longitude projection geotiff format. In addition, monthly global data at one degree, half degree and quarter degree latitude-longitude grids are available through the ISLSCP Initiative II web site (http://islscp2.sesda.com/ISLSCP2_1/html_pages/data_matrix.html).

Figure Captions

Figure 1. Spatial distribution of linear trends in GIMMS NDVIg AVHRR dataset from 1982 to 2003, calculated with monthly 1degree data.

Figure 2. NDVI Range (A) calculated by the maximum-minimum, and the mean NDVI (B) of the GIMMS NDVIg dataset, bimonthly composites from 1981-2004. Panel C shows a time series comparison with a 24x24 km box averaged for each time period for data from AVHRR NDVI, SPOT Vegetation, MODIS 500 m data and LandSAT ETM+ scenes that have been atmospherically corrected (Morisette et al., 2004). The LandSAT data has both the mean of the subset and the standard deviation of all pixels in the mean, showing the range of possible NDVI given the heterogeneous land cover types.

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Figure 1.

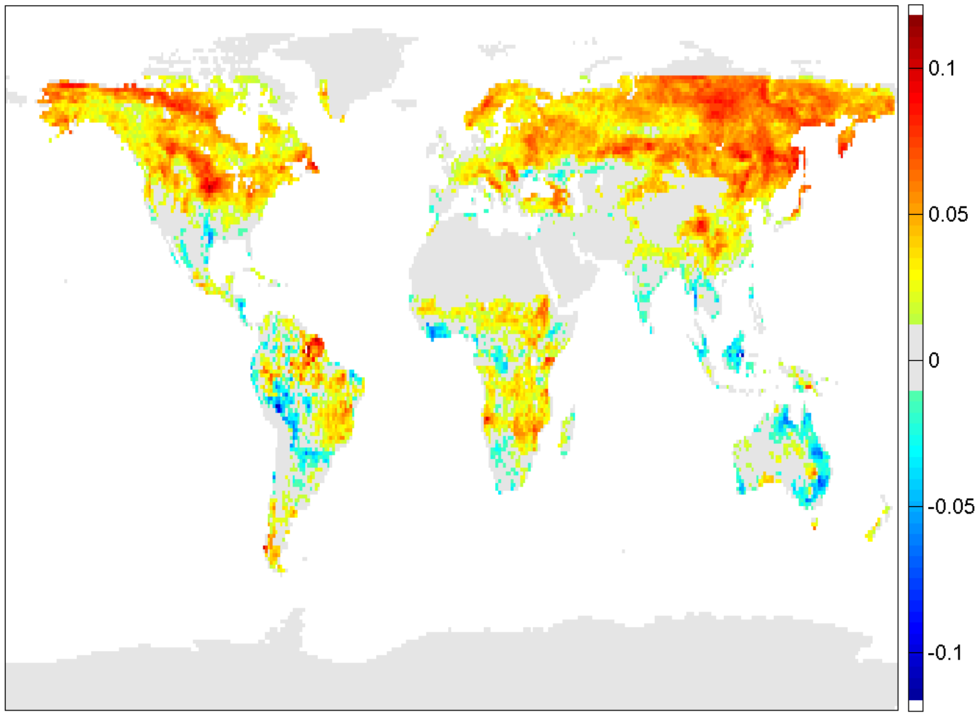
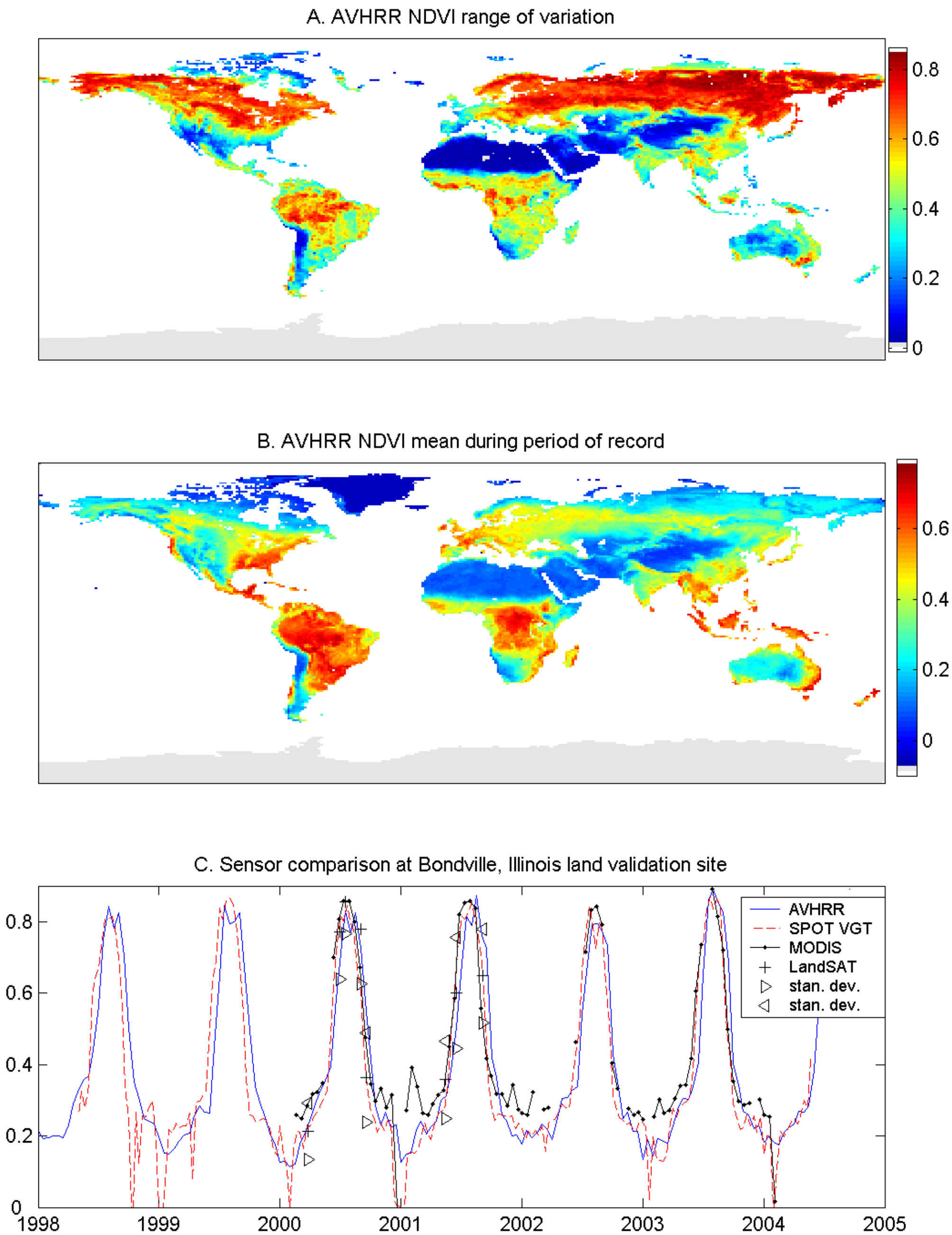


Figure 2.


A. AVHRR NDVI range of variation
0.8
0.6
0.4
0.2
0
B. AVHRR NDVI mean during period of record
0.6
0.4
0.2
0
C. Sensor comparison at Bondville, Illinois land validation site
0.8
0.6
0.4
0.2
0
1998
1999
2000
2001
2002
2003
2004
2005
AVHRR
SPOT VGT
MODIS
LandSAT
stan. dev.
stan. dev.